

What to Do if There Is No Reference System?

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Efficient management and regulation of anthropogenic point source inputs require a demonstrated and measurable ecological effect. In all ecosystems, evaluation of anthropogenic effects is confounded by the effects of naturally existing environmental factors and river nonpoint source inputs.

Field comparative studies that attempt to use a “reference system” to establish anthropogenic point source impacts usually assume that natural factors and river nonpoint source inputs are equivalent or “sufficiently close” in the test and reference systems. A generic approach is developed here which does not require the existence of a true reference system and is based upon an estuarine case study.

This case study uses two “comparative” estuaries for determining whether the benthic assemblages in a third test estuary have been impacted. We compared the major natural factor (salinity) and the river nonpoint source nutrient input (dissolved inorganic nitrogen, DIN) in test and comparative estuaries. The test estuary (New Bedford Harbor, MA) has multiple anthropogenic point source inputs, while two nearby estuaries (West Branch of the Westport River Estuary and Slocums River Estuary) have none. We used the benthic assemblages of each estuary as our indicator of an ecological effect.

The benthic assemblages should order in the same rank as the natural and nonpoint source factors if there were no other major factors affecting the test estuary. The data showed that the average salinity was statistically different among all three estuaries and DIN loadings were statistically different between Slocums River Estuary and the other two systems. These natural and nonpoint source factors were ordered by their degree of impact; the results of statistical analysis of the benthic assemblages were also ordered, using the Bray-Curtis similarity index and a multidimensional scaling graph. The benthic assemblage of the test system (New Bedford Harbor) did not follow the rank order as established by the levels of salinity and DIN. This correlative evidence indicated that neither reduced salinity nor DIN can explain the benthic state in New Bedford Harbor and the most likely cause for the altered rank order is the effect of anthropogenic point sources.

This comparative estuarine approach can provide an effective tool to assist environmental managers in appropriate allocation of resources for environmental remediation.